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FRETTING FATIGUE AND CORROSION
FATIGUE OF METALLIC MATERIALS

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Final Contractual Report

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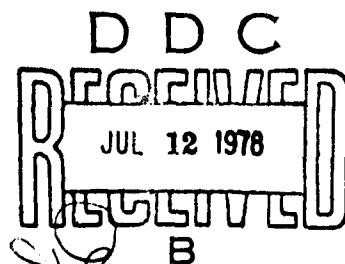
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by D.W. Hoeppner

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Introduction

This report summarizes the results of a 2½ year study undertaken on fretting initiated fatigue. It includes a brief statement of the problem, a summary of the important results, a list of publications and technical reports, and a list of degrees earned by students that participated in the research.

Statement of the Problem

Fretting initiated fatigue is plaguing the industrial and government community because of a lack of knowledge pertaining to the fundamental mechanisms involved in the process and also because of a lack of understanding of the parameters that influence the process. Consequently, this effort was undertaken to investigate the effect of crystallographic orientation on the fretting fatigue behavior of single crystals of iron, aluminum and copper. These materials were selected as model materials representative of the body-centered cubic and face-centered cubic crystal systems. In addition, the effect of grain size on the fatigue and fretting

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fatigue of copper polycrystals was studied in an attempt to delineate differences in the fretting fatigue process in single crystals or polycrystals. These studies were accompanied by scanning electron fractographic studies that aided in the interpretation of results.

Summary of Important Results

The results are presented in detail in the reports listed in the following section. However, several major results have emerged from these studies. First, it has been determined that in copper and iron crystallographic orientation influences the fatigue and fretting fatigue behavior. However, there is virtually no fatigue life reduction from the fretting being introduced to the fatigue of single crystals. It has been suggested that the ductility of the surface layer is so great in the single crystals that the fretting mechanical damage has no strain concentrating effect. Thus, no fretting life reduction is observed. However, in the polycrystals of copper and iron a fretting fatigue life reduction occurs and this life reduction has been observed to be dependent on grain size.

Publications and Reports

The following publications and reports (theses) detail the findings on the program.

1. D.W. Hoepfner, G.C. Salivar, "The Effect of Crystallographic Orientation on Fatigue and Fretting-Initiated Fatigue of Copper Single Crystals", Wear 43 (1977), 227-237.
2. V.P. Shah, M.S. Thesis, The Residual Fatigue Life of 1020 Steel and 7075-T6 Aluminum as a Function of Initial Flow Size, May 1976.

3. G.C. Salivar, M.S. Thesis, The Effect of Crystallographic Orientation on Fatigue and Fretting of Copper Single Crystals, August 1976.
4. E.R. Nickel, M.S. Thesis, Fatigue and Fretting Fatigue of Polycrystalline Copper, May 1978.
5. J. Sweigart, M.S. Thesis, Fatigue and Fretting Fatigue Behavior of Single Crystals of Iron and Polycrystalline Steel, Expected Completion August 1978.

Personnel

Degrees Obtained by Students Funded on Army Research Office Grant

Full Support

1. Vidyut Shah, M.S., May 1976.
2. Gary Salivar, M.S., August 1976

Partial Support

3. Eugene Nickel, M.S., May 1978.
4. John Sweigart, M.S., Expected August 1978.

Other personnel contributing

Professor David Hoepfner, principal investigator

Professor David Hansen

Professor Sudarshan Loyalka

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report describes the research performed on single crystals of copper and iron, and polycrystals of copper and iron under fatigue and fretting fatigue loading conditions. The orientation of the crystal has a pronounced effect on the fatigue behavior of both the copper and iron fatigue and fretting fatigue behavior. The introduction of a fretting component produces no degradation of fatigue behavior for either the copper or iron for the conditions studied. However, when fretting is		

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introduced on the polycrystals of copper and iron a serious reduction in fatigue life occurs.

The report summarizes the documents generated and the major findings of the research as briefly elucidated above.

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